(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 March 2006 (23.03.2006)

PCT

(10) International Publication Number
WO 2006/029465 A1

(51) International Patent Classification:
B01D 65/08 (2006.01)

(21) International Application Number:
PCT/AU2005/001405

(22) International Filing Date:
15 September 2005 (15.09.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2004905317 15 September 2004 (15.09.2004) AU

(71) Applicant (*for all designated States except US*): **U.S. FILTER WASTEWATER GROUP, INC.** [US/US]; 181 Thorn Hill Road, Warrendale, PA 15086 (US).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **ZHA, Fufang** [AU/AU]; 15A Grand Avenue, West Ryde, NSW 2114 (AU). **JOHNSON, Warrren, Thomas** [AU/AU]; 87 Avoca Road, Grose Wold, NSW 2753 (AU). **BECK, Thomas, William** [AU/AU]; 121 Keda Circuit, North Richmond, NSW 2756 (AU). **PHELPS, Roger, William** [AU/AU]; 32 Reading Avenue, Kings Langley, NSW 2147 (AU). **BROIS, Etienne, Ulysee** [FR/FR]; 6, rue de l'eglise, 91330 Yerres (FR).

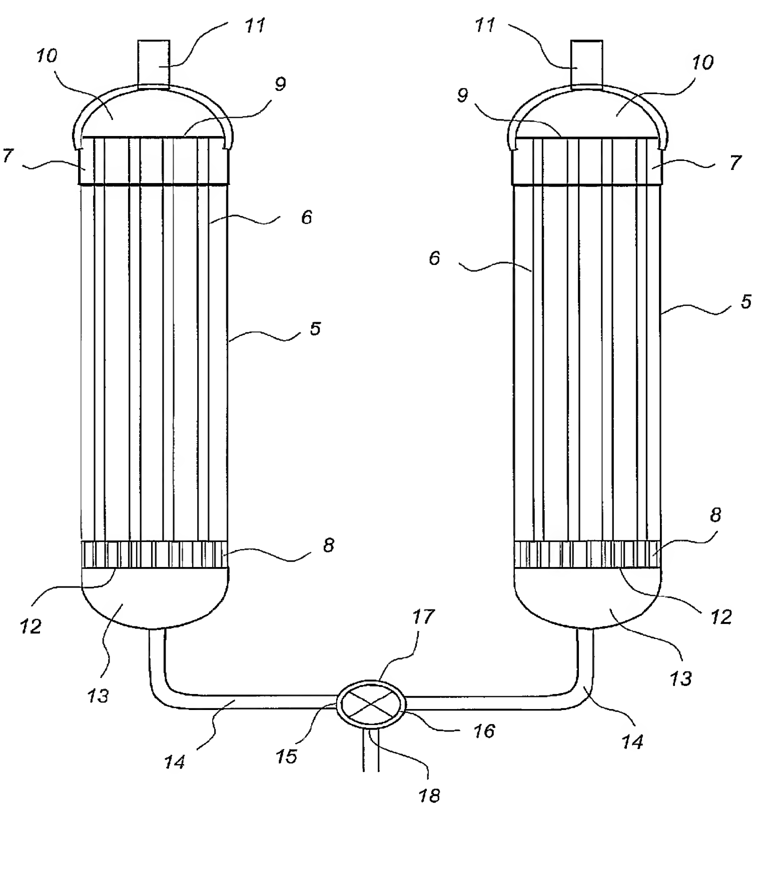
(74) Agent: **SHELSTON IP**; 60 Margaret Street, Sydney NSW 2000 (AU).

(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: CONTINUOUSLY VARIABLE AERATION



(57) Abstract: A method of controlling fouling in a membrane filtration system (5) of the type where gas is used to clean or scour the membranes (6) wherein the method includes supplying the gas to the system with a continuously variable flow rate. A continuously variable valve arrangement (17) is also disclosed.

WO 2006/029465 A1

ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE: Continuously Variable Aeration

TECHNICAL FIELD

The present invention relates to membrane filtration systems and more particularly, to the use of aeration to control fouling of the membranes in such systems.

BACKGROUND OF THE INVENTION

In submerged or immersed membrane filtration systems aeration using gas, typically air, is often employed on a continuous basis to control fouling. This is particularly the case for wastewater bioreactors. Other prior art systems utilise cycles of high gas flows followed by a lower gas flow or no gas flow. Mixtures of liquid/gas have also been used to scour the membranes and provide a reduction in gas consumption.

There are several problems with the cycling approach:

1. The cycle frequencies are typically very high, as it is not good to have the gas off in the process for too long as fouling increases rapidly during this phase. High cycle frequencies increase wear on valves that are required to cycle between multiple cells or membrane tanks, so as to keep the overall gas flow more or less constant from the blower. There are also practical limits to how fast the valves can be cycled between on and off caused by limitations of valve design and the time it takes to accelerate the gas flow.

2. When the gas is off for one cell it provides an opportunity for sludge to flow back into the aerators which can cause clogging of the aerators over time.

3. The longer the time between cycles the more likely it is for fouling to increase and the sludge to go anoxic.

DISCLOSURE OF THE INVENTION

According to one aspect, the present invention provides a method of controlling fouling in a membrane filtration system of the type where gas is used to clean or scour the membranes wherein the method includes supplying the gas to the system with a continuously variable flow rate.

For preference the system includes a number of modules and the supply of gas to each module has a continuously variable flow rate. Alternatively, the system may include a number of sets of modules and the supply of gas to each set of modules has a continuously variable flow rate. Optionally, the system may include a number of membrane tanks with each tank containing modules in sets. The supply of gas to each membrane tank and the sets of modules therein has a continuously variable flow rate.

Preferably the continuously variable gas flow rate, ranges from a high flow to a low flow (or to zero). For preference, the flow rate pattern of the gas flow follows any continuously variable curve that achieves this result such as a sinusoidal or triangular wave. The varying gas flow not only provides the normal cleaning effect but the unstable nature of the gas flow has been found to provide an additional cleaning effect resulting from the inherent surges in flow.

According to another aspect, the present invention provides a membrane filtration system including one or more membranes, a source of gas for providing a gas flow to form bubbles which scour the surfaces of the membrane, wherein said source of gas provides said gas flow at a continuously variable flow rate.

In one form, the gas source is coupled to the filtration system via a flow control device and the flow control device varies the flow rate continuously. In another form, the gas supply itself is varied, for example by varying the drive speed in a gas blower. Various combinations of known valve arrangements may also be used to provide the continuously varying flow rate.

The invention may be applied to a variety of membrane filtration system and is particularly applicable to submerged or immersed membranes and may be used in pressurised and non-pressurised systems.

According to another aspect, the present invention provides a flow control device for use in the control of the flow of aerating gas in a membrane filtration system, said flow control device including a housing having an inlet port and one or more outlet ports, a movable valve member for providing a continuously variable flow from said inlet port to said one or more outlet ports.

The housing may also be provided with a plurality of inlet ports.

Where a number of membrane modules or cells are used within the membrane filtration system, a flow control device may be used having separate outlets connected to associated modules such that as the flow rate is being increased to one module or modules it is being reduced to another module or modules.

Preferably, the flow control device is a rotating or reciprocating valve.

The flow control device may also provide a variable distribution of gas to one location. Distribution of the gas to each outlet port can be of continuously varying flow or an on/off flow. A feature of the flow control device is that it operates in a continuously rotating manner, not an open/close static manner. In

the present application, the flow control device is used to provide a continuously variable flow rate of gas to one or more locations.

In a preferred form, the rotating valve is made up of three main components, the valve housing, the rotating distributor and the drive motor. The valve housing is mounted to the motor and contains the inlet and outlet ports of the valve. The distributor is located within the valve housing and is driven by the motor. As the distributor rotates within the valve housing, it closes and opens the housing outlets and thereby directs gas out one outlet or out another.

The number of outlet ports within the housing can vary, thus providing control of the airflow to any desired number of locations.

The shape of the distributor can be varied to suit the number of outlet ports and to control the rate of airflow distributed through each outlet port.

Hence the valve may be used to control gas flow to a number of membrane modules or cells and optimise the total volume of gas used.

The valve is able to complete the function that would normally be achieved by a combination of standard valves.

The valve has negligible operating friction and therefore has a long operating life expectancy.

The valve operates in a continuous rotating manner and can therefore cycle at a wide range of frequencies; typically 60 to 0.05Hz.

BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic drawing of one embodiment of a filtration system according to the invention;

Figure 2 shows a graph of air flow-rate over time for continuous variation versus cyclic variation of airflow;

Figure 3 shows a perspective cutaway view of the rotating valve which may be employed in the invention;

Figure 4 shows a graph of air flow rate over time for the rotating valve of the time illustrated in Figure 3 against the ideal continuous flow pattern;

Figure 5 shows a schematic sectional elevation view of a further type of valve which may be used to produce continuous variation in air flow rate;

Figure 6 shows a graph of air flow rate over time for a valve of the type illustrated in Figure 5; and

Figure 7 shows a graph of transmembrane pressure (TMP) over time for a filtration module first having scouring by continuous variation in air flow rate and secondly having a cyclic flow rate.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, a pair of typical membrane filtration modules 5 is shown. Each module 5 includes a plurality of hollow fibre membranes 6 extending between upper and lower headers 7 and 8. Filtrate is withdrawn from the upper header 7 through the open ends 9 of fibre membranes 6 which open into collection chamber 10 connected to outlet 11. The lower header 8 has a plurality of openings 12 connected to a chamber 13 which in turn is connected to an inlet pipe 14. Each pipe 14 is connected to a respective outlet port 15 and 16 of a rotating valve 17. The valve 17 has an inlet port 18 connected to a source of pressurised gas, typically an air blower or pump (not shown).

The ideal gas flow pattern for continuous variation of the gas flow rate of gas used in scouring the membranes against a cyclic gas flow pattern is shown in Figure 2.

Figure 3 shows the rotating valve 17 in more detail. The valve 17 comprises a valve housing 19 with a rotating distributor 20 rotatably mounted therein and driven by a motor 21. The housing 19, in this embodiment has a centrally located inlet port 18 and two outlet ports 15 and 16, though it will be appreciated that the number of ports can be varied to suit different applications.

In operation, gas is supplied to inlet port 18 of the rotating valve 17. The distributor 20 continuously rotates within the housing 19 slowly opening one outlet port to the inlet pipe 14 of one module 5, increasing to full flow, then slowly restricting the flow and eventually closing it at the same time as the flow path reaches fully open on the next module 5. It will be appreciated that any number of modules can be used and the appropriate number of outlet ports can be provided in the valve housing 19. The cycling period of the gas flow can be readily adjusted by altering the speed of rotation of the distributor 20.

The gas supplied to the inlet pipe 14 is fed through openings 12 to scour the membranes in the normal manner.

Figure 4 shows a graph of the gas flow rate produced by the rotating valve of Figure 3. The small plateaus in the pattern were produced by minor leakage of the cylinder and the pattern will approximate the ideal flow rate if this leakage is minimised.

Figure 5 shows an alternate embodiment of a continuous flow rate valve. In this embodiment a piston 25 is slidably mounted in a tubular valve body 26 having outlet ports 27 and 28 at either end and an inlet port or opening 29 in the

wall of the valve body 26. Typically the valve body 26 would be cylindrical in shape though other cross-sectional shapes could be used.

In use, the piston 25 reciprocates within the valve body 26 so as alternately fully open the input port 29 to output ports 27 and 28, respectively. The range of piston movement is arranged such that when port 29 is fully open to port 27 it is fully closed to port 28 and vice versa. As the piston 25 moves between its limits the gas flow to one outlet port is gradually increased while the gas flow to the other outlet port is correspondingly reduced.

Figure 6 illustrates the pattern of continuously variable gas flow rate produced by the valve arrangement of Figure 5.

Figure 7 shows the effect of continuous variable gas flow rate on the scouring process. The first part of the graph shows change in transmembrane pressure (TMP) with a continuously varying gas flow rate (pulsatile flow) to the membranes while the second portion of the graph illustrates change in TMP with a cyclic gas flow rate. As more efficient scouring produces a more stable TMP over time, it is clear from this graph that the continuously variable gas flow rate produces a more efficient scouring effect and a more stable TMP over time than the cyclic flow rate scouring.

The advantages which may be typically provided by the method and system according the embodiments of the invention are:

1. The gas flow is only at the low or zero point for a very short period of time. This minimises the opportunity for backflow of sludge within the filtration system.

2. The essentially continuous flow of gas also means that the period of the cleaning/scouring cycles may be extended over the conventional “alternating” approach. This is achievable because the gas flow is not in the low or no flow

condition for very long so there is less likelihood of sludge settling and for anoxic conditions to develop.

3. The process may be employed by using a variable speed drive on a blower and programming the flow cycle profile, in which case there would be no valve issues, as they are not required to cycle. Or alternatively, if conventional valves are used to control the cycles, then the longer period that the process enables means less wear of the valves.

4. The process may also be employed by using a rotary valve described in the preferred embodiment. In this embodiment the blower runs at essentially constant speed, and the valve rotates continuously. There is no sudden open close action on the valve and only the one valve is required.

5. Using the rotary valve above also enables much shorter cycle periods to be obtainable by increasing the speed of the valve rotation.

6. There is a potential saving in gas requirements of up to 50%.

It will be appreciated that further embodiments and exemplifications of the invention are possible without departing from the spirit or scope of the invention described.

CLAIMS:

1. A method of controlling fouling in a membrane filtration system of the type where gas is used to clean or scour the membranes wherein the method includes supplying the gas to the system with a continuously variable flow rate.

2. A method according to claim 1 wherein the system includes a number of modules and the supply of gas to each module has a continuously variable flow rate.

3. A method according to claim 1 wherein the continuously variable gas flow rate ranges from a high flow to a low flow.

4. A method according to claim 3 wherein the low flow is zero.

5. A method according to claim 1 wherein the flow rate pattern of the gas flow follows a continuously variable curve in the form of a sinusoid.

6. A method according to claim 1 wherein the flow rate pattern of the gas flow follows a continuously variable curve in the form a triangular wave.

7. A membrane filtration system including one or more membranes, a source of gas for providing a gas flow to form bubbles which scour the surfaces of the membrane, wherein said source of gas provides said gas flow at a continuously variable flow rate.

8. A membrane filtration system according to claim 7 wherein the rate of flow of gas from said gas source is continuously variable.

9. A membrane filtration system according to claim 8 wherein said gas source is a variable speed blower.

10. A membrane filtration system according to claim 7 wherein said gas source is coupled to the filtration system via a flow control device and the flow control device varies the flow rate continuously.

11. A membrane filtration system according to claim 10 wherein said membrane filtration system includes a plurality of membrane modules and said flow control device has separate outlet ports connected to associated modules such that as the flow rate is being increased to one module or modules it is being reduced to another module or modules.

12. A membrane filtration system according to claim 10 wherein said membrane filtration system includes a number of sets of modules and the gas flow to each set of modules has a continuously variable flow rate.

13. A membrane filtration system according to claim 12 wherein the membrane filtration system includes a number of feed containing vessels with each feed containing vessel having a respective set of modules located therein.

14. A membrane filtration system according to claim 10 wherein said flow control device includes a housing having an inlet port and one or more outlet ports, and a movable valve member for providing a continuously variable flow from said inlet port to said one or more outlet ports.

15. A membrane filtration system according to claim 14 wherein said movable valve member is a rotating distributor positioned within said housing to control flow from said inlet port to said one or more outlet ports.

16. A membrane filtration system according to claim 15 wherein said outlets ports are located relative to the rotating distributor such that one of said outlet ports is fully open when another is fully closed.

17. A membrane filtration system according to claim 14 wherein said movable valve member is a reciprocating distributor positioned within said housing to control flow from said inlet port to said one or more outlet ports.

18. A membrane filtration system according to claim 17 wherein said outlets ports are located relative to the reciprocating distributor such that one of said outlet ports is fully open when another of said outlet ports is fully closed.

19. A membrane filtration system according to claim 17 or claim 18 wherein said reciprocating distributor includes a piston slidably mounted in said housing, said housing being tubular and said outlet ports being located at either end thereof and said inlet port being located in a wall of said housing intermediate of the ends thereof.

20. A membrane filtration system according to claim 19 wherein said piston is arranged such that, as the piston moves between its limits, flow from the inlet port to one of said outlet ports is increased and the flow to another of said outlet ports is reduced.

21. A membrane filtration system according claim 14 wherein the movable valve member is continuously driven by a motor.

22. A membrane filtration system according claim 14 wherein said housing has a plurality of inlet ports.

23. A flow control device for use in the control of the flow of aerating gas in a membrane filtration system, said flow control device including a housing having an inlet port and one or more outlet ports, a movable valve member for providing a continuously variable flow from said inlet port to said one or more outlet ports.

24. A flow control device according to claim 23 wherein said movable valve member is a rotating distributor positioned within said housing to control flow from said inlet port to said one or more outlet ports.

25. A flow control device according to claim 24 wherein said outlets ports are located relative to the rotating distributor such that one of said outlet ports is fully open when another is fully closed.

26. A flow control device according to claim 23 wherein said movable valve member is a reciprocating distributor positioned within said housing to control flow from said inlet port to said one or more outlet ports.

27. A flow control device according to claim 26 wherein said outlets ports are located relative to the reciprocating distributor such that one of said outlet ports is fully open when another of said outlet ports is fully closed.

28. A flow control device according to claim 26 or 27 wherein said reciprocating distributor includes a piston slidably mounted in said housing, said housing being tubular and said outlet ports being located at either end thereof and said inlet port being located in a wall of said housing intermediate of the ends thereof.

29. A flow control device according to claim 28 wherein said piston is arranged such that, as the piston moves between its limits, flow from the inlet port to one of said outlet ports is increased and the flow to another of said outlet ports is reduced.

30. A flow control device according to claim 23 wherein the movable valve member is continuously driven by a motor.

31. A flow control device according to claim 23 wherein said housing has a plurality of inlet ports.

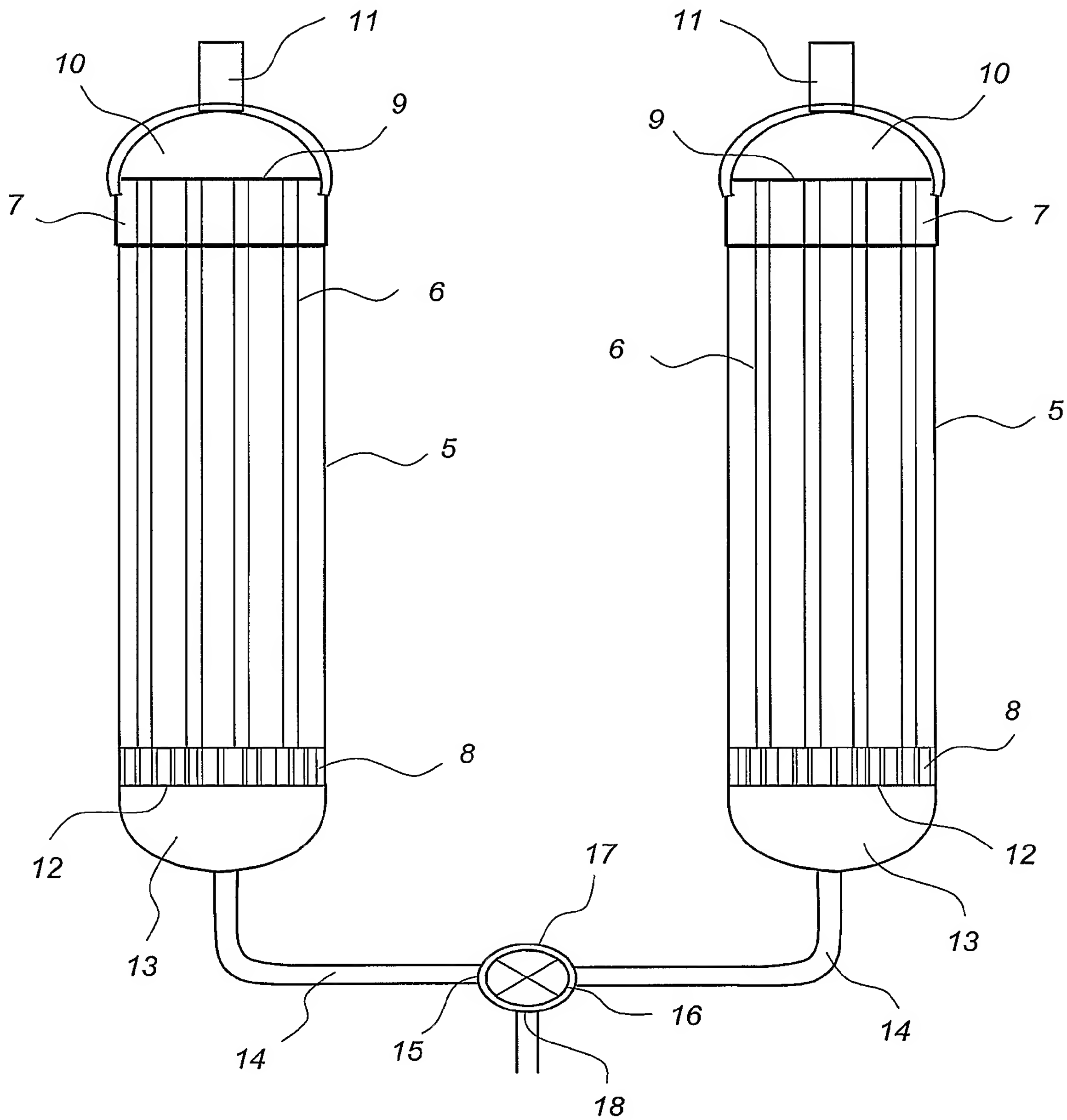


Fig. 1

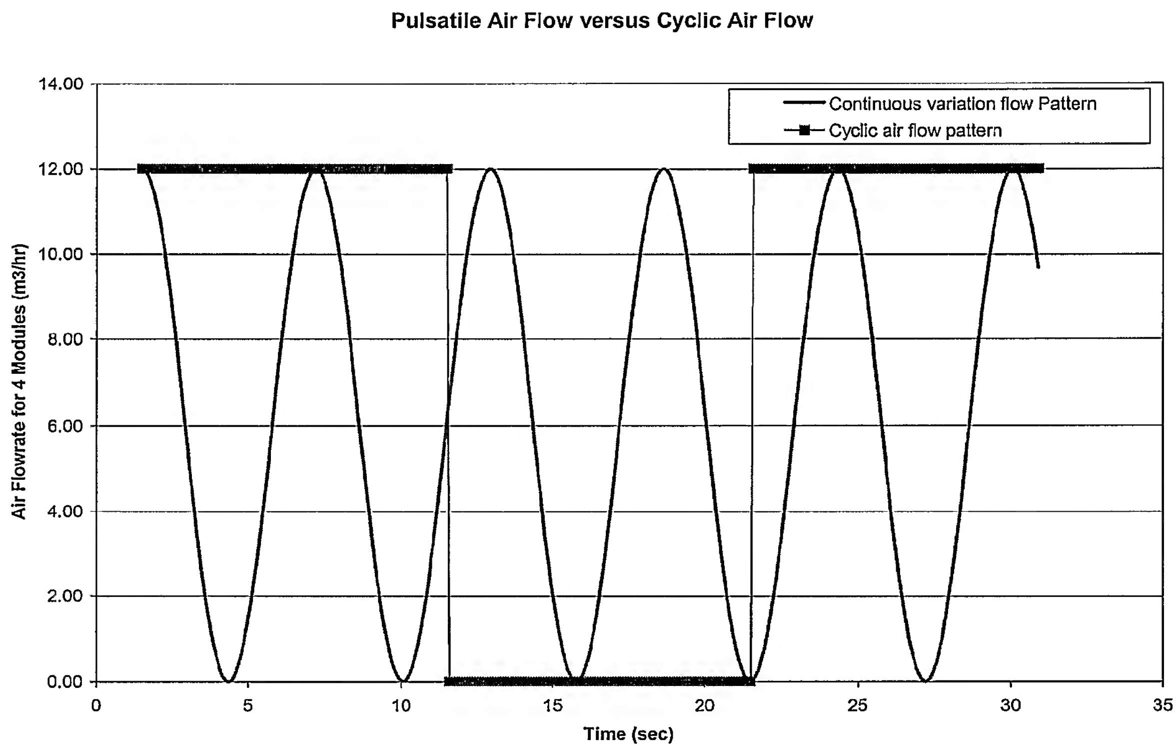

Pulsatile Air Flow versus Cyclic Air Flow
Continuous variation flow Pattern
Cyclic air flow pattern
Air Flowrate for 4 Modules (m3/hr)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
5
10
15
20
25
30
35
Time (sec)

Fig. 2

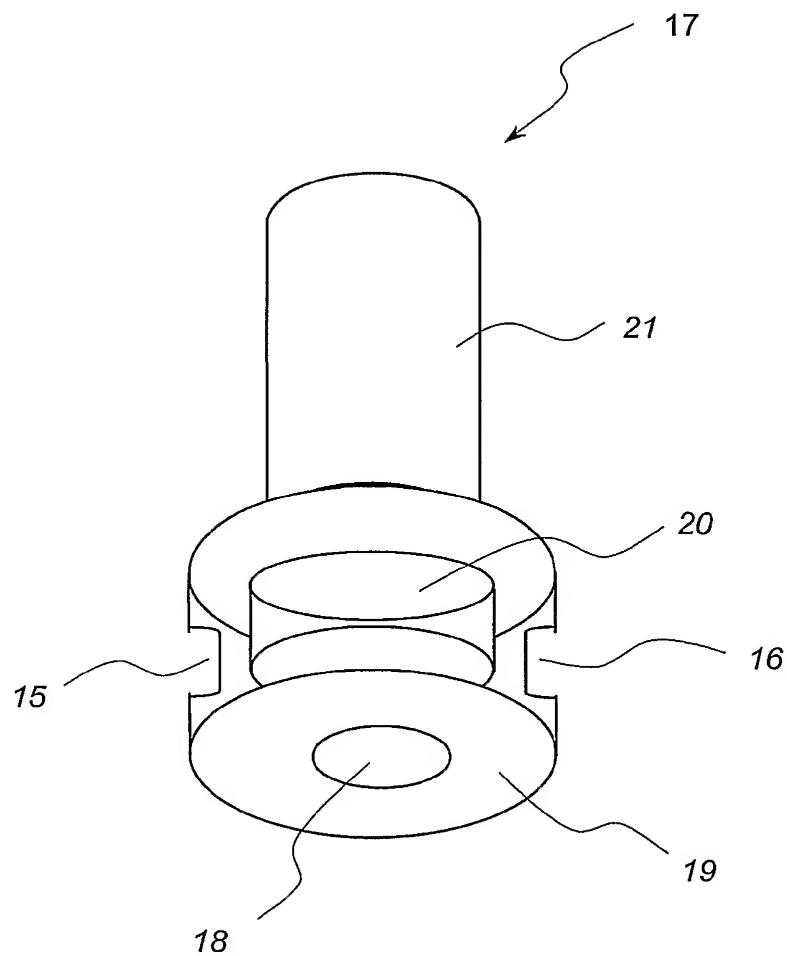


Fig. 3

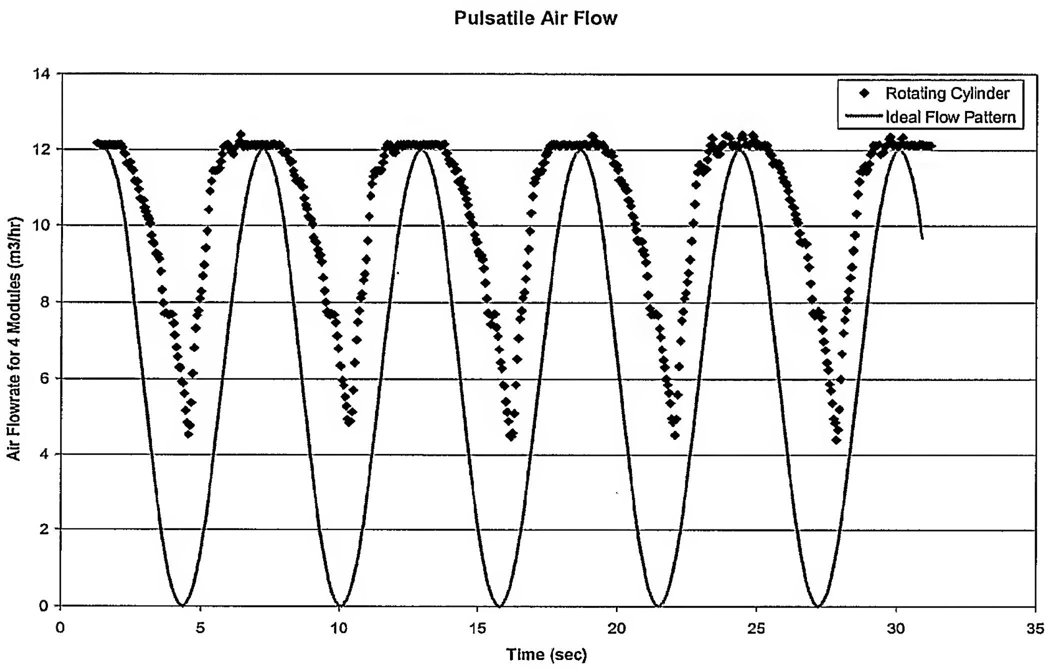

Pulsatile Air Flow
Rotating Cylinder
Ideal Flow Pattern
Air Flowrate for 4 Modules (m3/hr)
Time (sec)
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
35

Fig. 4

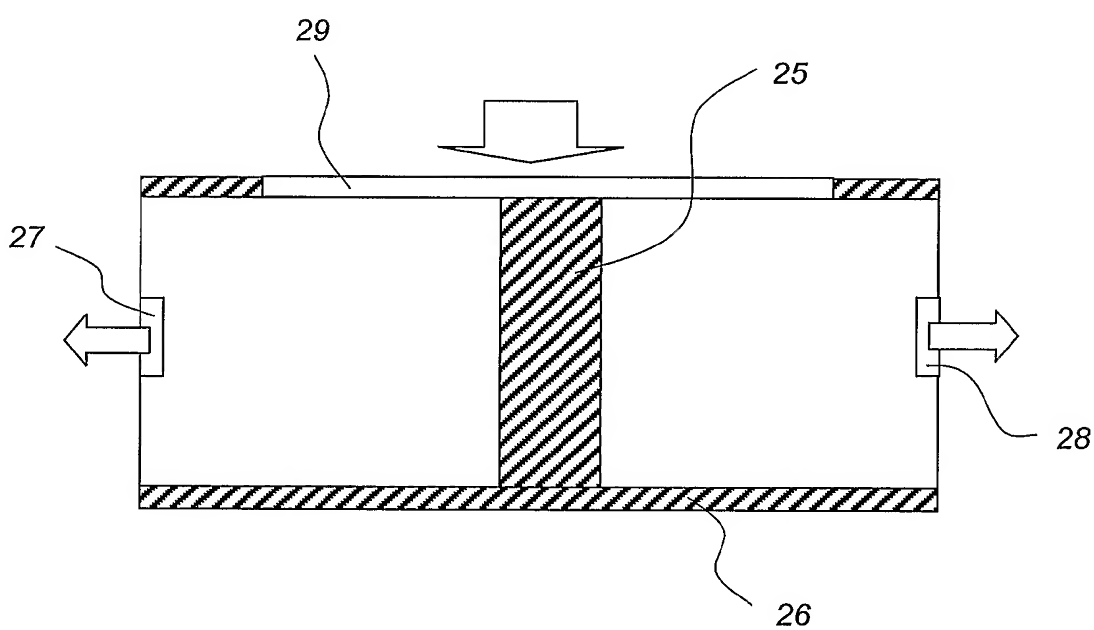


Fig. 5

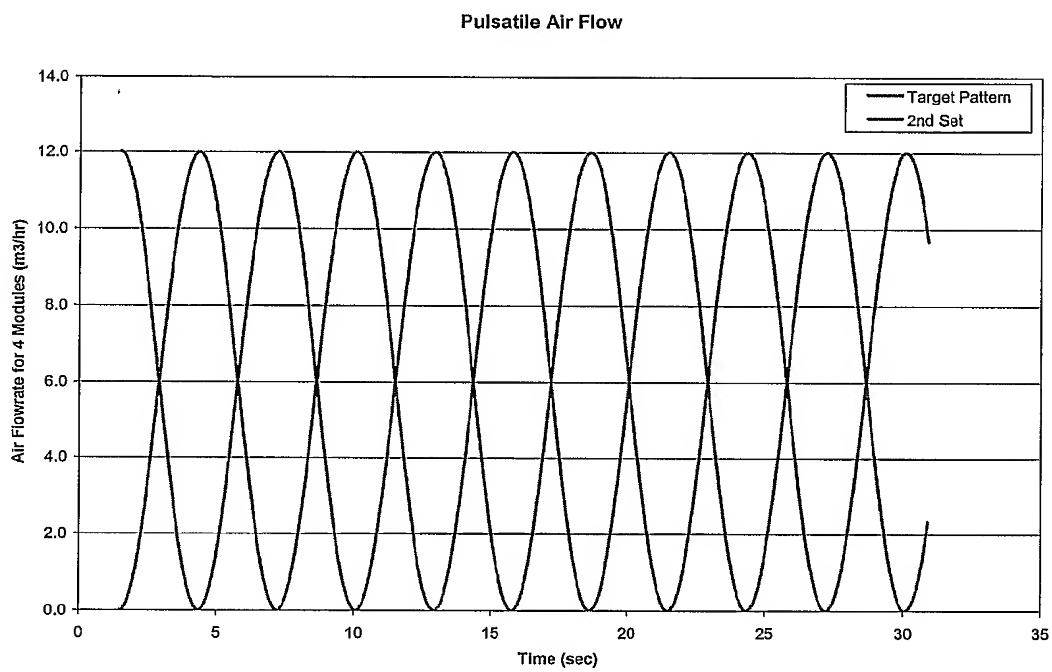

Pulsatile Air Flow
Target Pattern
2nd Set
Air Flowrate for 4 Modules (m3/hr)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
5
10
15
20
25
30
35
Time (sec)

Fig. 6

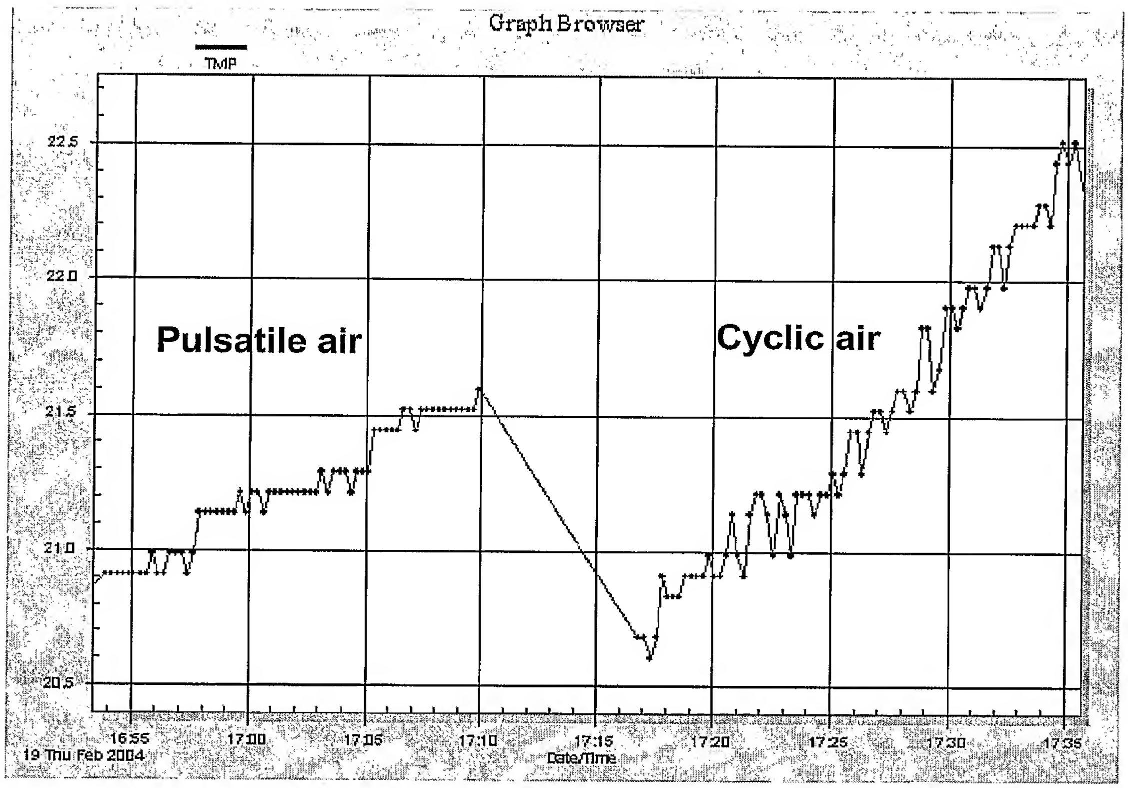

Graph Browser
TMP
22.5
22.0
21.5
21.0
20.5
Pulsatile air
Cyclic air
16:55
17:00
17:05
17:10
17:15
17:20
17:25
17:30
17:35
19 Thu Feb 2004
Date/Time

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/001405

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

B01D 65/08 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent DWPI: IPC B01D 65/- and keywords AERAT, SCOUR, BUBBL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/056458 A2 (HYDRANAUTICS) 8 July 2004 See whole document	1-4,7-10, 12,13
X	US 2002/0153313 A1 (COTE) 24 October 2002 See whole document	1-4,7-10, 12,13
X	Derwent Abstract Accession No. 97-081592/08, Class D15 J01, JP 08323161 A (HITACHI PLANT ENG & CONSTR CO LTD) 10 December 1996	1-4,7-10, 12,13
X	Derwent Abstract Accession No. 2004016339/02, Class J01, JP 2003340250 A (KURITA WATER IND LTD) 2 December 2003	1-4,7-10, 12,13

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 December 2005	14 DEC 2005

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

MATTHEW FRANCIS
Telephone No : (02) 6283 2424

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 1999-398718/34, Class D15, JP 11156360 A (KUBOTA CORP) 15 June 1999	1-4,7-10, 12,13
P,X	Derwent Abstract Accession No. 2005-421091/43, Class D15, JP 2005144291 A (NGK INSULATORS LTD) 9 June 2005	1-4,7-10, 12,13

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2004056458	AU	2003297476	EP	1585590	US	2004139992
US	2002153313	AU	12558/00	AU	13764/01	AU	13767/01
		AU	14308/99	AU	60738/99	AU	66528/96
		AU	2004203855	AU	2004203856	BR	9914376
		CA	2227692	CA	2278085	CA	2279766
		CA	2290053	CA	2307492	CA	2308230
		CA	2345682	CA	2348186	CA	2360425
		CN	1336847	CZ	20011236	DE	4025516
		EG	21552	EG	22686	EP	0846023
		EP	1053054	EP	1119522	EP	1140330
		EP	1146954	EP	1146955	EP	1170052
		EP	1213048	EP	1252921	EP	1369165
		EP	1445240	EP	1452493	EP	1527810
		EP	1559472	HK	1045471	HU	0103786
		HU	0105236	PL	347240	PL	348909
		US	5639373	US	5783083	US	5910250
		US	5944997	US	6042677	US	6193890
		US	6245239	US	6294039	US	6319411
		US	6325928	US	6375848	US	6550747
		US	6620319	US	6656356	US	6682652
		US	6685832	US	6706189	US	6708957
		US	6790360	US	6863823	US	6881343
		US	6893568	US	6899811	US	6899812
		US	6964741	US	2001027950	US	2001027951
		US	2002130080	US	2002134740	US	2002139748
		US	2002153299	US	2002179517	US	2003127389
		US	2003136746	US	2003141248	US	2003164332
		US	2004007527	US	2004035780	US	2004112831
		US	2004113293	US	2004118767	US	2004182771
		US	2004206683	US	2004238432	US	2005006308
		US	2005082227	US	2005092674	US	2005115900
		US	2005121389	US	2005127000	US	2005161384

		US	2005173342	US	2005178728	US	2005184002
		WO	0021890	WO	0030742	WO	0136074
		WO	0136075	WO	9706880	WO	9929401
		WO	02094421				
JP	8323161	NIL					
JP	2003340250	NIL					
JP	11156360	NIL					
JP	2005144291	NIL					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX